BEFORE THE ARIZONA CORPORATION COMMISSION

CARL J. KUNASEK
Commissioner - Chairman
JIM IRVIN
Commissioner
WILLIAM A. MUNDELL
Commissioner

IN THE MATTER OF THE GENERIC INVESTIGATION OF THE DEVELOPMENT OF A RENEWABLE PORTFOLIO STANDARD AS A POTENTIAL PART OF THE RETAIL ELECTRIC COMPETITION RULES.	DOCKET NO. E-00000A-99-0205 **NOTICE OF FILING TESTIMONY**

Pursuant to the Hearing Division's June 16, 1999, Procedural Order, the Arizona Clean Energy Industries Alliance ("ACEIA") hereby files its responses to the questions and issues presented by the Hearing Division in the form testimony prepared by Robert H. Annan, William Gould, Donald E. Osborn and J. Michael Davis.

RESPECTFULLY SUBMITTED this 30th day of July, 1999.

MARTINEZ & CURTIS, P.C.

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The original and ten (10) copies of the foregoing are filed this 30th day of July, 1999 with:

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Service List for Docket No. E-00000A-99-0205

By Paul R Michel

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TESTIMONY OF ROBERT H. ANNAN

On Behalf of

ARIZONA CLEAN ENERGY INDUSTRIES ALLIANCE ("ACEIA")

July 30, 1999

PREPARED TESTIMONY OF

ROBERT H. ANNAN

Q. Please state your name, title and business address.

A. My name is Robert H. Annan. I am an energy consultant with the Annan-Mooney Group and the lead organizer of the Arizona Clean Energy Industries Alliance. My business address is 6605 East Evening Glow, Scottsdale, Arizona 85262.

Q. Who are you testifying on behalf in this proceeding?

A. I am testifying on behalf of the Arizona Clean Energy Industries Alliance.

Q. What is the Arizona Clean Energy Industries Alliance?

A. The Arizona Clean Energy Industries Alliance ("ACEIA") is an alliance of local and national companies active in manufacturing, installing and marketing photovoltaic, solar thermal and other solar and renewable energy products and services. The companies that currently comprise ACEIA include the Arizona Solar Attic Systems, Inc., ASE Americas, Inc., Bechtel, Inc., BP Solarex, Inc., Conservative Energy Systems, Inc., Deluge, Inc., Desert Sun Solar, Inc., Diversified Technical Services, Inc., E V Products, ElectriSol, Ltd., Energy Conversion Devices, Entech, Inc., Energy Photovoltaics, Inc., ETA Engineering, First Solar, General Solar, Golden Genesis Company, Heliocol Arizona, Inc., Janus II Architects and Planners, NAPV, North Canyon Construction, Pacific West Solar, Photovoltaic Systems Manufacturing, L.L.C., Photovoltaic Resources International, Inc., Progressive Solar, Inc., Science

Applications International Company, Stirling Energy Systems, Inc., Sun Earth, Inc., Siemens Solar, SolarBuilt, L.L.C., Solar Wholesale, Solec, Inc., Spire Corp., Sun Systems, Inc., SunLite Works, Inc., SunPower of Arizona, The Solar Store, United Solar Systems Corp. and York Research Corporation.

Q. Why is ACEIA participating in this matter?

A. As explained above, ACEIA is an alliance of forty private companies (and growing) active in manufacturing, installing and marketing photovoltaic, solar thermal and other solar and renewable energy products and services. We want to invest in Arizona because we believe that Arizona's favorable business climate, abundant sunshine, and proximity to Mexico create vast opportunities for solar related industries to locate and expand their operations here. Accordingly, ACEIA desires a Portfolio Standard that would infuse a level of "economic certainty" into the development of solar and other renewable energy applications in the state. ACEIA believes that economic certainty is the leaking element necessary to attract new investors to Arizona and help high-tech companies obtain financing to expand business in the state.

Q. Please state your qualifications to testify on behalf of ACEIA in this matter.

A. I have thirty five years experience in energy research and development. Specifically, from 1964 to 1975, I was a staff member for Vice Admiral Rickover at the Atomic Energy Commission Department. That office was responsible for developing nuclear propulsion for Navy ships.

From 1975 to 1996, I held various positions at the U. S. Department of Energy. I was mainly responsible for renewable energy development. From 1982 to 1995, I was the Director of the Department Solar Energy Research and Development. While the Director, I was heavily involved in research and development of photovoltaics, solar thermal and biomass power technologies. In addition to directing technology research and development, I designed partnerships to accelerate the commercialization of new energy technologies.

From 1994 to 1996, I served as the Special Assistant to the Secretary of Energy. As the Special Assistant, I was responsible for all renewable energy matters. I also lead energy trade missions to India, China, Latin America and South Africa.

I am currently a Senior Associate for the Winthrop Rockefeller Foundation at Winrock International where I advise on renewable energy based rural electrification programs worldwide. As a partner at the Annan-Mooney group, I regularly consult with high-tech industries, universities, and national and international institutions on renewable energy matters.

Q. Are there any other persons providing testimony on behalf of ACEIA in this matter supporting the proposed Portfolio Standard?

Yes. David Gould, a Project Manager for Bechtel, will provide testimony for the purpose of presenting the status of solar trough electric power technologies. Next, Don E. Osborn, the Manger/Supervisor of the Sacramento Municipal Utility District's ("SMUD") PhotVoltaic & Distributed Technologies department will provide testimony supporting the promotion of a sustained and orderly development of solar and renewable technologies from a Utilities' perspective. Finally, Mike Davis, the president and CEO of Golden Genesis, will provide testimony supporting the proposed Portfolio Standard from an Arizona business perspective.

Q. Should there be an Environmental Standard in Arizona and why?

A. Yes, there should be and Environmental Standard in Arizona. We believe that by adopting the proposed Environmental Portfolio Standard ("Portfolio Standard") as part of the competition rules, the Commission would help Arizona fully realize the economic and environmental benefits of solar energy and other renewable energy resource applications. We prefer the proposed Portfolio Standard because it is market based. Thus, it creates choices within the workings of the restructured electricity system and promotes values favorable to renewable energy. We believe that this will lead to a sustainable renewable energy industry that would serve the state's clean energy needs. We also believe that without a Portfolio Standard, the objective of the Electric Service Providers ("ESP") and Utility Distribution Companies ("UDC") may

be only utilize the least cost energy resources available which are also the most environmentally harmful.

Accordingly, a properly administered Solar Portfolio program would encourage the ESPs and UDCs to stimulate strategic alliances, create buy-down opportunities, promote in-state manufacturing, build larger markets, and stimulate cost reductions through economies of manufacturing. From an energy policy standpoint, additional benefits include: increased fuel diversity, enhanced export potential, greater use of distributed generation that reduces the load on existing transmission lines and peaking power needs, the creation of new state industries and jobs leading to additional state revenues, a significant contribution to a cleaner environment and the recognition of Arizona as national and international renewable resources leader.

Q. What should be the objectives of an Environmental Portfolio Standard and who should bear the costs of the Standard and how should those costs be collected?

A. Generally, the objective of the Portfolio Standard should be to foster the deployment of a substantial amount of new solar and renewable energy technologies under a market driven approach. Although, the 200 MW maximum potential of the market by the year 2005 would represent the single largest market for solar energy in the world, this would be small compared to Arizona's total generating capacity. Companies involved in solar and other renewable energy technologies, such as ACEIA, maintain

that Arizona would benefit from a Portfolio Standard through: (1) increased fuel diversity, (2) increased utility and electric service provider expertise and experience, (3) the development of new solar electric technologies, (4) the encouragement of distributed solar generators to reduce the loading on existing transmission lines, (5) the contribution to the commercialization of solar electricity, (6) the contribution of economic benefits throughout Arizona: and, (7) cleaner air and other environmental benefits.

We believe that at this time it is appropriate for the ESPs and the UDCs will bear these obligations. The amount of this obligation and the mechanism to collect is explained in more detail further in my testimony. ESPs and UDCs will have a variety of ways to minimize the costs that they occur through the implementation of free market strategies.

Q. Does Arizona have sufficient solar resources to sustain a Portfolio Standard?

A. Yes. Please see the map attached to this testimony which shows that Arizona's solar resources are among the best in the world. For example, a field of photovoltaic solar collectors 90 miles on a side, approximately the size of Cochise County, located in Arizona would provide enough electricity to power the United States for lifetime of the collectors, thirty years or more. The required land area could be met by rooftops, windows, parking garages, almost any exposed surface. It would take 5 billion barrels

of oil yearly for thirty years to provide an equivalent amount of power. At today's import prices, the total value would equal $3 trillion dollars.

Q. What technologies are available to convert Arizona's solar resources into clean energy? Please summarize the current status of each technology and costs.

A. The technologies available to convert solar resources to clean energy are wide in scope. They include a wide variety of applications from directly heating water and air to creating electricity. Two major groups of technologies include: (1) photovoltaic-based systems that generate electricity: and, (2) solar thermal systems that generate electricity or displace electricity consumption. Although solar energy systems are capital intensive, the fuel is free, infinite and no adverse environmental impact. Cost reduction in solar arise from economies of manufacturing. By contrast, fossil-based technologies including coal or gas fired plants may have comparable low capital costs. The fuel, however, is polluting, non-renewable and costs and availability are uncertain over the long term due to our heavy reliance on oil imported from the middle-east. Fossil-fired plants also may have environmental impact costs not yet known.

The United States is currently the world's leader in research, manufacturing, and creation of solar and other renewable energy markets. The solar and renewable energy industry consists of hundreds of firms selling low and high temperature systems for heating water and homes, and systems that generate electricity. The industry estimates that by the end of this year there will be over 12 million working solar hot water and

photovoltaic systems worldwide. In 1998, the total industry sales were more than $600 million. The industry is experiencing sales growth of 20% per year, comparable to the growth experienced by the semiconductor industry in its early years.

The total cost of solar and renewable energy technology depends on a number of factors including installed technology, size of system, volume of users, capacity factors, operation and maintenance costs, technology life, power resale price, retail power rates, and discount rate.

Solar Water Heating Systems. Residential solar water heating systems range in cost from approximately $2000 to $5000 when installed at a retail level. The cost of the system is dependent on the size and type of the system, the number of people the system will serve and the difficulty of the installation. Solar water heating systems range in size from 66, 82 to 120 gallons in size and serve 2 to 4, 4 to 6, 6 to 8 family members respectively. For example, an 82 gallon system would range in cost from $2,500 to $3,200 on a retail basis. Larger systems that can accommodate larger households and/or additional loads are also readily available.

If ESPs and UDCs decided to undertake a residential solar hot water installation program, they could most likely be positioned to sell the systems at much lower retail prices than the retail prices listed above. For example, it is estimated that an ESP and UDC could expect to install an 82 gallon system for a cost of approximately $1,800. This would include a wholesale equipment cost of $1,200 and an installation cost of

around $600. Through purchasing on a volume basis directly from a manufacturer on a truckload basis, an ESP or UDC could expect to reduce the wholesale cost of the solar equipment to approximately $1000. Additional savings on equipment through economies of manufacturing could be realized when a market develops that would encourage the mass production of systems on a large scale.

The current cost for an installed commercial solar water heating system is well known. For example, the solar hot water system acquired by a north Phoenix federal prison, which replaces about 600 kWs of electricity, was sold and installed for $550,000 or $900/kW. This solar powered system now provides 185-degree water for cooking, laundry and bathing and is expected to save the prison $6,000 a month in electricity costs.

Photovoltaics. Photovoltaics ("PV") is a semiconductor-based technology which converts light energy directly into electric current that can either be used immediately or stored, such as in a battery, for later use. PV panels are very versatile and can be mounted in a variety of sizes and applications. For example, they can be mounted on the roof or awning of a building, on roadside emergency phones or as very large arrays consisting of multiple panels. The U.S. leads the world in development of PV technology. PV systems are currently providing electricity services for: communications, health care, crop irrigation, water purification, lighting, cathodic protection, environmental monitoring, marine and air navigation, utility power and to

other residential and commercial applications. Over 200,000 homes in the U.S. use some type of PV technology and the market is expanding at a healthy 20% annually. cells (solar cells) convert the light of the sun directly into electricity.

PV systems costs vary by application. Stand alone-distributed system costs range from 6,000 kW for grid tied systems to 8,500 -10,000 kW installed for remote stand-alone systems. The remote systems are cost effective when located more than 1/3 mile from the nearest grid. They are cost effective against battery and small diesel engines. At 6,000 kW, PV systems produce electricity at peak demand rates charged by Arizona's current utility companies. The photovoltaic industry recently concluded that reducing costs to $3,000 was possible by 2010 at market growth rates of 25% per year. At $3,000, grid-connected photovoltaic systems and begin to be cost effective against grid power resale rates.

Solar Trough Electric Power. Generally, parabolic troughs consist of long rows of concentrators that are curved in only one dimension, forming troughs. The troughs are mounted on a single-axis tracking system that tracks the sun from east to west. They are lined with a reflective surface that focuses the sun's energy onto a pipe located along the trough's focal line. A heat transfer fluid is circulated through the pipes and then pumped to a central storage area where it passes through a heat exchanger. The heat is then transferred to a working fluid, usually water, which is flashed into steam to drive a conventional steam turbine engine. In utility scale applications, the steam produced from the parabolic trough plant typically is supplemented with a natural gas-

fired superheater. The biggest advantage that parabolic troughs have relative to the other solar thermal electric technologies is their relatively advanced stage of commercialization. For example, nine solar generating station power plants, with a combined output of 354 MWe, are currently in operation in the Southern California desert. Each of the nine plants operate reliably, and with predictable annual solar-to-electric performance. William Gould, a representative of Bechtel Corporation, provides testimony detailing his companies solar trough electric power applications along with supporting cost data.

The Solar Energy Enhanced Combustion Turbine ("SEECOT") system is another example of solar trough electric power in commercial operation. The SEECOT system is a simple and cost effective application of solar energy that can be used with either simple or combined cycle combustion turbine plants. In a typical application, the generating capacity of a gas turbine operating in a hot climate, such as Arizona, would be increased from 72 MW to 94 MW and the heat rate reduced by approximately 10,000 Btu's/kWh to less than 9,000 Btu's/kWh. The cost of this capacity increase would be approximately $750/kW and the "pure" solar energy content would be approximately 9MW, i.e. 10% of the plants maximum output. The remaining 13 MW increase in generation capacity is a result of the inlet air cooling and steam augmentation of the combustion turbine. SEECOT systems have been proven to preserve the environment. For example, a SEECOT equipped 80 MW gas

turbine would typically reduce CO2 emissions in the state by 12,000 tons per year as opposed to a gas turbine plant without a SEECOT system.

Parabolic Dishes. Parabolic Dish generating systems consist of parabolic-shaped point-focus concentrators that reflect solar energy onto receiver mounted at the focal point. Parabolic dishes typically use dozens of curved reflective panels made of glass or laminated films. These concentrators are mounted on a structure that uses a two-axis tracking system to track the sun. The concentrated sunlight is focused on a receiver, where it may be utilized directly by a cycle heat engine mounted on the receiver, or the sunlight can be used to heat fluid that is transmitted to a central engine. Point-focus concentrator systems, such as parabolic dishes and central receivers, typically achieve higher conversion efficiencies than line focus concentrators, such as parabolic troughs, because they operate at higher temperatures. Parabolic Dishes are considered a promising solar thermal technology because of their modularity, short installation time, siting flexibility, minimal water requirements and high conversion efficiencies. Based on $1500/kW, the "solar only" operation of a Dish Stirling power plant will provide a LEC of 8 to 12 cents kWh depending on whether the plant is a public or privately financed utility. If part of the Dish Stirling plant is operated in a "hybrid" mode (i.e., landfill gas will be used instead of solar energy to power some of the Stirling genset systems), the blended LEC can then be reduced to 4 to 7 cents/kWh.

Q. Are there currently any barriers to the implementation of solar and renewable energy technologies?

A. Yes. First, the fossil fuels industry is heavily subsidized by the federal government creating an artificial price barrier to new technologies such as solar and renewable energy. According to the U.S. Department of Energy, the fossil fuels industry received subsidies amounting to $150 billion between 1918 and 1978. Current estimates place federal fossil fuel subsidies to the fossil fuels industry at $5 billion annually. While the cost of solar and renewable energy is also considered a barrier to the advancement of renewable energy, take away the federal fossil fuels subsidies and solar and renewable energy becomes more competitive with to fossil fuel.

Second, restrictive codes, covenants and restrictions (CC&Rs) in planned communities create a barrier to solar and renewable energy technologies by preventing their wide-spread use. For example, despite the fact that laws have been passed in many states, including Arizona, that prohibit such restrictions, many homeowners who wish to install solar energy systems on their homes are prohibited by their homeowners associations.

Third, a general lack of awareness and understanding of solar and renewable energy technologies by building officials and other members of the building community creates a barrier to the implementation of solar and renewable energy technologies.

For example, many building codes make it difficult or impractical for consumers to install solar and renewable energy systems.

We believe that good public policy supporting solar and renewables, such as the proposed Portfolio Standard, would greatly assist in overcoming these barriers.

Q. Does the State of Arizona currently offer any incentives for the installation of solar energy Devices?

A. Yes. Arizona offers a state income tax credit for the installation an approved solar energy device. A taxpayer is allowed a direct tax credit of 25% of the cost of an approved solar energy device with a $1000 maximum credit allowed. The state also allows for an exemption of sales taxes paid on the retail sale of a solar energy device. Additionally, builders of new homes, who install the necessary transport plumbing lines for the installation of solar water heating systems in new home construction, are allowed to take a tax credit of $75 for each home built. A tax credit of $75 is also allowed for the installation of an electrical line for recharging electric vehicles.

Q. Will the proposed new Portfolio Standard meet the desired objectives or would you propose an alternative mechanism? How?

A. Yes. The new Portfolio Standard meets the desired objectives for a number of reasons. First, it is the next logical step in Arizona's ongoing commitment to solar and renewable energy. For example, to date the Affected Utilities' have installed over 500

kWs in Arizona and has over twenty years of experience using solar electric systems. Tucson Electric Power has an affiliate, Global Solar, which will manufacture photovoltaic panels. Native Sun, Inc., a Hopi enterprise, has sold and installed over 300 household systems on the Hopi Reservation.

Second, the new Portfolio Standard is the most market orientated of the alternatives because it creates a market-based approach to the development of solar and renewable energy. It encourages the ESPs and UDCs to meet the standard by developing market strategies to attract customers. Such strategies could include investment and manufacturing, making bulk purchases, packaging systems for green markets, providing financing packages, and installing, operating and maintaining systems for customers.

Third, the new Portfolio Standard creates market size and certainty. This combined with Arizona's favorable high-tech business climate and proximity to Mexico and Central and South America, encourages solar related industries to locate and expand their operations in the state. It should be noted that because other states such as Nevada, Texas and California are establishing policies to attract solar and renewable energy technologies, our failure to establish the proposed Portfolio Standard in Arizona may put the state at risk of losing the thousands of new and important jobs that will be created as a result of these new technologies.

Fourth, the Portfolio Standard would enhance the electric restructuring process. A key change brought about by the new competitive environment will be the way value is created by the participants. The Portfolio Standard enhances this new value system with new modular technologies compatible with choice programs. The Portfolio Standard is also most responsive to the expected needs for peaking power, power quality control, local reliability assurance, growth on existing grid feeds, as well as enhancing the cost effectiveness for remote loads.

Fifth, the Portfolio Standard would reduce the cost of electricity by reducing the demand on old peaking plants through "peak shaving". For example, the demand for electricity in the Phoenix metropolitan area is increasing by about 3% a year. While many of the utilities have sufficient generating capacity from coal plants located well outside of the metropolitan area, the transmission lines connecting the plants to the metropolitan area are often full. This makes it necessary for the utilities to dispatch several small "peakers" located within the metropolitan region more and more often. These peaking plants, however, are usually quite old and inefficient. For every MW of power that they generate, typically more than twice as much fuel is consumed than in a new more efficient modern plant. Thus, where gas fired combined cycle plants can produce power at about 3 cents/kWh, the cost of power from these old plants is typically in the 6 to 10 cent/kWh range. Accordingly, solar power, which is available exactly at the time of peak power demand, could be used to reduce this demand resulting in less need for the utility to use its inefficient and expensive peakers.

Hence, the use of solar energy for "peak shaving" could effectively lower the cost of electricity.

Last, the non-compliance provisions of the Portfolio Standard provide strong incentives for ESPs to seek market based market strategies rather than pay the penalty.

Q. Are you supportive of the proposed Portfolio Standard and, if not, describe any modifications that you would make to the proposed Portfolio Standard (including responses to 6 below) or describe your Company's proposed alternative mechanism.

A. Yes, we support the Portfolio Standard. However, we would like to see a slight modification to the Portfolio Standard allowing consumer owned and financed systems to also qualify for the Standard. Also, net metering, which was eliminated from a prior version of the Retail Electric Competition Rules, should be reinstated. Last, we would strongly urge that the Commission add a provision that gives certainty to the Portfolio Standard through 2010. Certainty is important to solar industries companies wishing to located and expand in the state in order to procure the proper financing and attract investors.

Q. If you are proposing an alternative to the proposed Standard, include a detail description of: (1) technologies to be included; (2) timing; (3) any incentives; (4) cost projection of the alternative over the life of the alternative; (5) impact on customer rates; (6) all major assumptions for the proposed alternative.

A. We support the current proposed Portfolio Standard and do not propose any wholesale changes to the proposed Standard.

Q. Should the Standard be imposed only on sales in the competitive market?

A. No. In order to achieve the market size necessary to attract businesses and cost reductions, by necessity, the Portfolio Standard must include all retail sales. Under the proposed Portfolio Standard both ESPs and the UDCs will be treated the same.

Q. Instead of implementing a Standard as part of the Retail Electric Competition Rules, should the market (the retail consumers themselves) dictate the amount of "green" power to include in competitive energy services? Should the Commission encourage Energy Service Providers to offer programs, instead of mandating rigid targets, allowing the market for such products to develop naturally?

A. No. Voluntary programs have not lived up to expectations. For example, in 1993 Arizona Utilities agreed to strive towards a pre-set MW goals from renewables by 2000. They have fallen woefully short. However, while performing against this target there are success stories. SRP and APS both have over-subscribed to green marketing

programs. A voluntary green market program is not a good alternative to the portfolio standard. A Portfolio Standard is required to create the level of market certainty necessary to encourage the solar industry to make the commitments necessary to allow solar to compete with the established (and heavily subsidized) conventional energy technologies. However, we do see green marketing as a good alternative for ESPs as an effective tool in marketing green power.

Q. Would it be appropriate to include recovery of costs of renewable systems in a systems benefits charge rather than the general cost/rate structure?

A. No. This would require a whole new program under the SBC model. The SBC approach to solar energy development would put its implementation solely in the control of the wires' companies. Thus, there would be no incentive for wires companies to pursue the objectives of the portfolio standard. In addition, it would create a large bureaucratic administrative process with centralized procurement. Such a process tends to freeze investment and technology growth awaiting the outcome of such procurement. Under such a system the ratepayer will likely pay more for solar and renewable power and get less in return.

Q. New section N of the Portfolio Standard allows for "environmentally-friendly renewable electricity technologies" other than solar. Which technologies should be included in this subsection? Would those technologies be available in Arizona or work in Arizona?

A. Wind, fuel cells, geo thermal, landfill gas and modular bio-mass would be applicable in Arizona. But the indigenous resource base for the technologies are quite small in Arizona. As explained, solar resources are quit abundant in Arizona.

Q. In subsections A and B of the proposed Portfolio Standard, a schedule of portfolio percentages is defined. Is the size of portfolio percentage and timing of increases a reasonable strategy to be included in the competition rules? What alternatives would you propose and why?

A. Yes. The Portfolio Standard has already been compromised three times. It should compromised no further, but implemented as quickly as possible.

Q. The proposed Portfolio Standard includes incentives for in-state manufacturing and in-state installation of solar and other environmentally-friendly technologies. Are those incentives appropriate and substantial enough to have a positive impact on Arizona's on Arizona economic development? What alternatives would you propose and why?

A. Yes. The incentives for in-state manufacturing and in-state installation will have a positive effect on Arizona economically. The industry believes that they are mutually

supporting and by linking the incentives together under the portfolio standard, an environment will be created that will attract solar and renewable manufacturing to Arizona. There are currently five photovoltaic firms that are planning plant expansion and awaiting the outcome of the environmental portfolio standard before making a final decision. A revitalized market for solar hot water systems would see a return of manufacturing of solar thermal systems in the state as well. Recent activities in the Tucson area have demonstrated that an additional incentive as small as $500 has a dramatic stimulating effect on the solar water heating market. A favorable decision on a portfolio standard would have the effect of creating up to 500-1000 new jobs in the near term. This job creation would more than off-set the negative effects of the recent down turn in the state's copper industry.

We propose no alternatives to the Portfolio Standard.

Q. What long-term benefits will the proposed Portfolio Standard have on the State of Arizona and its residents? Specific items to be addressed include job creation, maintenance of energy dollars in the local economy, load diversification, and pollution prevention.

A. Economic Benefits. The Solar Portfolio would create new jobs in the state. Nationally, in 1995, over 45,000 jobs were directly or indirectly related to energy efficiency and renewable energy programs. The use of solar and renewable energy is expected to double by the year 2010, which would create more than 350,000 new jobs. Over the next 25 years, the worldwide market for renewable/solar energy efficiency

represents a multi-trillion dollar opportunity for U.S. firms. For example, in Wisconsin, it is predicted that a 75% increase in renewable energy use would result in more than 62,000 new jobs and $1.2 billion in new wages.

In addition to the creation of new jobs, the Solar Portfolio would save money and keep the money in the community. The investment in solar and energy-efficient technology increases local economic activity in three ways. First, local businesses that sell solar energy conserving goods and services benefit directly. Second, a regenerative cycle is created when funds realized through the sale of energy saving goods and services are reinvested in these businesses. Third, lower utility bills for commercial and residential energy consumers will result in increased profits and disposable income. With all three effects, much of the profits or money saved will be spent locally. An input/output analysis demonstrates that for each $1.00 spent to acquire energy resources from outside of the community generates only $0.33 of economic activity within the community. In contrast, for each $1.00 spent within the community produces, through the economic multiplier effect, about $1.67 of local economic activity.

Environmental Benefits. The Solar Portfolio would make Arizona's air cleaner. The total 200 MW market is the equivalent of eliminating 45,000 cars from the state's roads. The Arizona Department of Environmental Quality states that Arizona, specifically Maricopa County, has air quality problems with three major air pollutants:

(1) carbon Monoxide, (2) particulate; and, (3) Ozone. In fact, the EPA has classified the Phoenix area as a "non-attainment area" meaning that this area does not meet the air quality standards. Statistics show that about 98% of U.S. carbon dioxide emissions are caused directly by the combustion of fossil fuels, and electricity generation from fossil fuels is the largest single source of carbon emission is the U.S.

We believe that the demand for electricity in the state and particularly in Phoenix is increasing at a rate of about 3% a year. While the utilities have sufficient generating capacity, e.g. well outside the metropolitan region the transmission lines into the metropolitan area where the power is needed are full, which means that several small "peakers" located within the metropolitan region are dispatched "on" more and more. These peaking plants, however, are mostly quite old and inefficient. We believe that for every MW of power that they generate typically more than twice as much fuel is consumed than in a newer and more modern plant. Also, these old plants usually have no or inadequate emission controls, with the net result that a 3% increase of power demand during the hot summer months could result in a 30% increase in harmful NOX emission. Thus, we believe that they are a major contributor to Phoenix's current air quality problem. Accordingly, we believe that the sooner solar power, such as PV or solar thermal, can be installed in the metropolitan region, the quicker this problem can be alleviated.

Load diversification. Arizona is currently served primarily by fossil fuels and nuclear energy. The addition of solar and renewable energy technologies would reduce the states risk by adding new energy sources to the states energy portfolio. It is worth noting that of all the states adding solar and other renewable energy opportunities to their energy mix, Arizona has the greatest renewable solar availability.

Q. What would the impact be on an average competitive (residential and commercial) customer's monthly bill (assume 1,000 kWh/month usage for residential) of the proposed Portfolio Standard? (Please state assumptions, including technology costs).

A. At full 1% compliance in 2005 and assuming that an average customer's monthly bill (1,000 kWh/month) is $90.00, we believe that under the worst case scenario where the utility pay's the penalty under the Portfolio Standard, this would represent a $3.00/month increase on the customers monthly bill. Based on our cost estimates, however, minimal compliance would most likely result in a 10 cent per kWh impact resulting in a $1.00/month rate increase on a customers average monthly bill. At maximum compliance with the PS through aggressive marketing strategies including green pricing program and use of extra credit multipliers, we expect further cost reductions to 4 cents per kWh resulting in a 40 cent increase in the customers monthly bill.

In any event , the compliance costs would be more than off-set by the cost benefits promised by electric competition.

Q. Section 1609.B.2. provides for determination of a cost/benefit point in 2001 prior to an increase in the percentage in 2002. Is it appropriate to determine the cost/benefits point during this proceeding (and the corresponding impact on customers) or in 2001? Should the Commission cap the impact that the Portfolio Standard may have on customers?

A. We believe that the provision of new Portfolio Standard providing for a determination of a cost/benefit point is a reasonable challenge. It should be noted, however, that by January 2001, there may not be sufficient data on actual installed capacity to provide validate an actual cost/benefit point. Thus, we believe that some cost projections may be necessary. We do request that the working group membership be balanced between all of the interested parties.

Q. Section 1609.1 of the proposed Portfolio Standard allows for the "banking" or

A. We are in favor of the provision of the Portfolio Standard which allows for the "banking" or sale of excess solar kWh. The federal government and many states are contemplating a similar mechanism. We would work to make sure that the credit mechanism is market based and recognizes a private finance system in lieu of a large centralized administering bureaucracy.

Q. Section 1609.F provides for penalties if ESPs fail to meet the proposed Portfolio Standard. Are there additional provisions needed to require ESPs to issue RFPs or negotiate contracts in a timely fashion rather than merely paying the penalty?

A. There is concern in the environmental technology industry that the ESPs and UDCs will take the position of paying the fine rather than compiling with the standard. To prevent this, the rules should contain a provision that requires the ESPs and UDCs to enter into good faith effort to meet the goal of the Standard. Further, there should be a rule provision that requires the ESPs and UDCs to file a report with the Director of the Utilities Division within a reasonable time after the adoption of the Portfolio Standard.

Q. Should the proposed standard or any alternative that you are proposing apply to Standard Offer Customers in 2001? If yes, should the standard or alternative as applied to Standard Offer be energy driven (kWh) or dollar driven to limit or cap the impact on Standard Offer Customers? What would the impact be on an average residential and commercial customer's monthly bill? (Please state assumptions, including technology costs.) What mechanism should the Commission put in place to recover the costs from Standard Offer Customers?

A. First, we believe that the proposed Portfolio Standard should apply to standard offer customers in 2001. Second, we believe that the proposed Portfolio Standard, as applied to Standard Offer Customers, should be energy driven. Third, the impact of

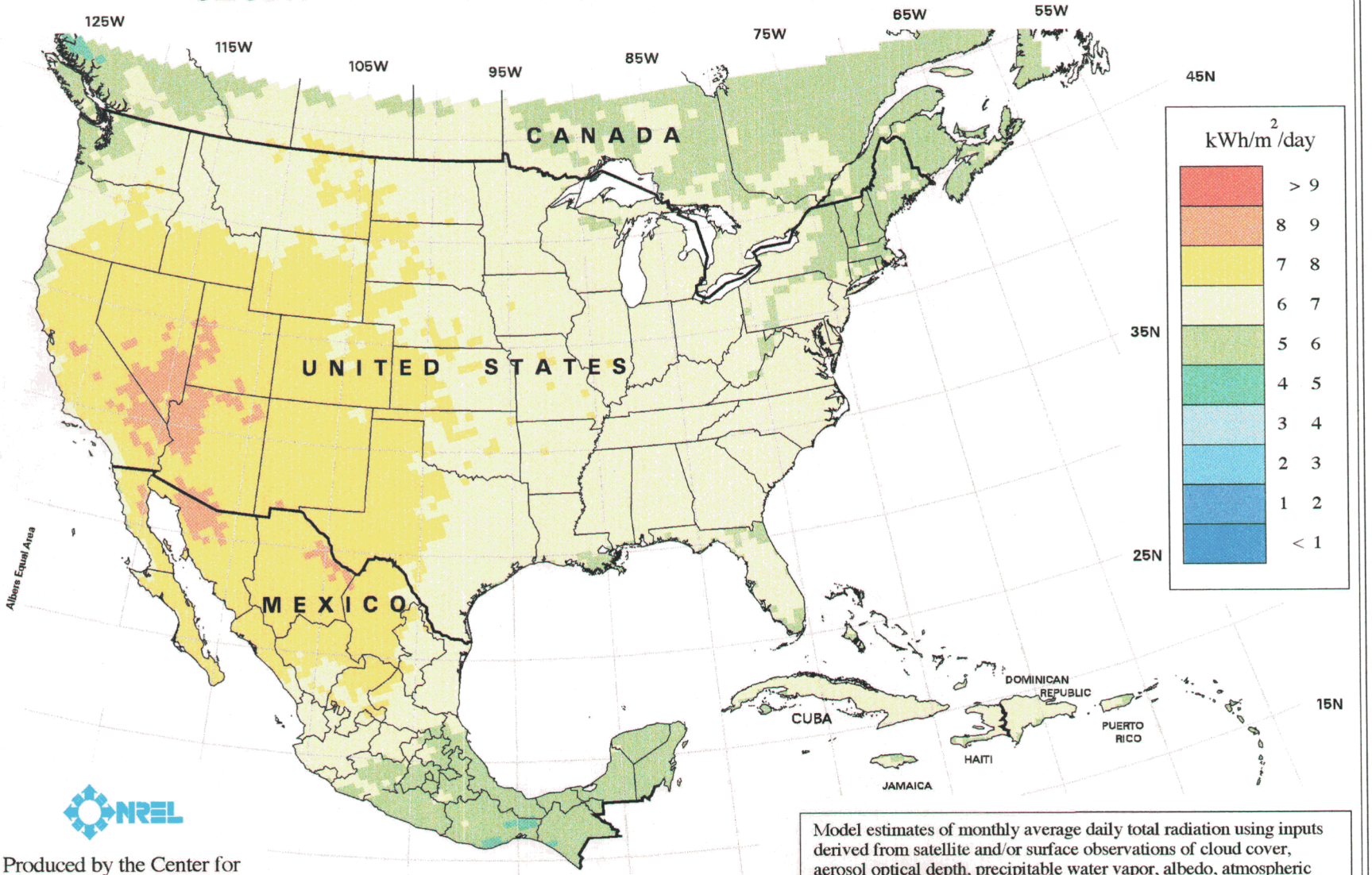
the Portfolio Standard on an average residential and commercial customer's monthly bill would be $1.00 in a worst case scenario. Last, we believe that the UDCs should recover costs associated with the Portfolio Standard as an expense bundled into the UDC's power supply component. The UDCs should be able to recover these costs through normal rate case proceedings before the Commission.

Q. Does this conclude your testimony?

A. Yes.

GLOBAL HORIZONTAL SOLAR RADIATION

JUNE



NREL

Produced by the Center for
Renewable Energy Resources May1997

LBrady 9700004/jungloin/18 Sep 97

Model estimates of monthly average daily total radiation using inputs derived from satellite and/or surface observations of cloud cover, aerosol optical depth, precipitable water vapor, albedo, atmospheric pressure and ozone resampled to a 40km resolution. See related documentation for more details including uncertainty analysis.

BEFORE THE ARIZONA CORPORATION COMMISSION

CARL J. KUNASEK
Commissioner - Chairman
JIM IRVIN
Commissioner
WILLIAM A. MUNDELL
Commissioner

IN THE MATTER OF THE GENERIC INVESTIGATION OF THE DEVELOPMENT OF A RENEWABLE PORTFOLIO STANDARD AS A POTENTIAL PART OF THE RETAIL ELECTRIC COMPETITION RULES.	DOCKET NO. E-00000A-99-0205

TESTIMONY OF DONALD E. OSBORN

On Behalf of

ARIZONA CLEAN ENERGY INDUSTRIES ALLIANCE ("ACEIA")

July 30, 1999

PREPARED TESTIMONY OF

DONALD E. OSBORN

Q. Please state your name, title and business address.

A. My Name is Don E. Osborn. I am the Manger/Supervisor of the Sacramento Municipal Utility District's PhotoVoltaic & Distributed Technologies ("PVDT") department which includes the Municipality's Solar Program. My business address is 6301 S Street, MS# A401, Sacramento, CA 95817.

Q. Who are you testifying on behalf in this proceeding and for what purpose?

A. I am testifying on behalf of the Arizona Clean Energy Industries Alliance ("ACEIA") to support the proposed Portfolio Standard for the purpose of promoting a sustained and orderly development of solar and renewable energy technologies in Arizona.

Q. Please state your qualifications to testify in this proceeding.

A. I am an engineer with over 20 years of professional experience in solar energy and energy management in the utility, academic, government and industrial sectors. At SMUD, I have been responsible for the development, implementation and conduct of the most extensive utility solar program in the country including PV, SDHW, Solar Buildings and Solar Thermal Power.

Since 1992, the SMUD Solar Program has been responsible for the installation of over 3000 SDHW systems and the operation of the world's largest Distributed Generation PV system (over 6 MW including more than 450 rooftop "PV Pioneers"). The PVDT Department is also responsible for the "Greenergy" green energy marketing program, Distributed Technologies including fuel cells and micro-turbines, and for Customer Advanced Technologies including geothermal heat pumps and advanced HVAC systems.

I currently serve on the national Boards of Directors of the Utility PhotoVoltaic Group ("UPVG") and the American Solar Energy Society (ASES). I also served on the Solar Energy Industries Association ("SEIA") board. From 1981 to 1991, I was the Director and Senior Research Specialist of the Solar and Energy Research Facility at the University of Arizona. From 1977 to 1981, I was the Associate Director of the Arizona Solar Energy Commission and Director of the Western SUN - Arizona office. From 1975 to 1977, I was a Research Engineer for Helio Associates, Inc. I have a MS in Energy engineering and a BS in Engineering Physics from the University of Arizona. I am the author of over 90 solar and energy publications. I am listed in Who's Who in Technology today and American Men and Women in science.

Q. Please describe the Sacramento Municipal Utility District.

A. The Sacramento Municipal Utility District ("SMUD") is the fifth largest public utility in the nation and serves a 900 square mile area in and near Sacramento County, California. SMUD's mission as a customer owned utility is to meet the electric and energy service needs of our customers in a safe, reliable, economic and environmentally responsible manner.

Q. Please describe SMUD's Photovoltaic Program.

A. SMUD has completed its first 5 year, 6 MW PV commercialization effort based on the sustained, orderly development of the utility PV market. SMUD has begun a 5 year, 10 MW program designed to complete a process that will result in PV being at a market competitive price by 2002 and as a sustainable business opportunity for SMUD. As part of this effort, by the end of 1997, SMUD had installed over 450 PV systems totaling 6 MW. These included over 420 residential rooftop systems as well as commercial buildings, parking lots and substation systems. Under its new Business Plan, SMUD has signed contracts for an additional 10 MW of PV systems for 1998 through 2002 with cost decreasing to less than $3/W. As part of its new competitive business strategy responding to changes the utility industry is undergoing, SMUD has incorporated PV as a key business opportunity. SMUD has established partnerships with its customers through the PV Pioneer "green pricing" program, with DOE and UPVG through TEAM-UP and Million Solar Roofs to advance PV commercialization

and to develop rooftops as "PV power plant" sites and with other utilities through its PV Partnership program.

Q: What are the basic business reasons for this program?

A. Restructuring and increased competition in the U.S. utility industry provide profound challenges and opportunities for commercializing photovoltaics. In September 1996, Assembly Bill 1890 directed a comprehensive restructuring of the electric industry in California. This restructuring sets forth a challenge of increasing competition more quickly than previously anticipated and requires new business strategies to respond to this rapidly changing business environment. The municipal values that SMUD is founded on are the foundations of the new SMUD competitive business strategy, a strategy that incorporates the continued sustained, orderly development and commercialization of photovoltaics (PV) as a core element expected to lead to a sustainable business opportunity. Investments made in solar power today are expected to provide the customer-owners of SMUD with substantial long-term energy and community benefits.

Q. Please provide more details on SMUD's Solar Program.

A. SMUD is continuing its sustained, orderly development (SOD) commercialization effort of the grid-connected, utility PV market. This program is aimed at developing the experience needed to successfully integrate PV as distributed generation into the utility

system, develop market and long-term business strategies and to stimulate the collaborative processes needed to accelerate the cost-reductions necessary for PV to be cost-competitive in these applications by about the year 2002.

SMUD is a leader in utility grid-connected applications of PVs with the world's largest distributed PV power system. The SMUD's PhotoVoltaic & Distributed Technologies Department (PVDT) is responsible for the District's Solar Program, Distributed Technologies, Greenergy Program, Customer Advanced Technologies, the operation of PVUSA (a national, collaborative PV RD&D Facility), and administration of State mandated Public Good Programs for Renewable Energy and RD&D. The SMUD Solar Program is a business development and commercialization effort for the sustained, orderly development of grid-connected PV, which has resulted in over 6 MW of PV systems installed in Sacramento. Through the integration of PV as a distributed component of the utility system, the SMUD Solar Program is part of a nationwide collaborative effort to accelerate the cost-reductions necessary for PV to be successful in the competitive utility market.

SMUD is continuing to play a leadership role in the commercialization of grid-connected PV through its own PV programs as well as helping to implement the collaborative state and national utility PV commercialization efforts underway with the Department of Energy (DOE), the Utility PhotoVoltaic Group (UPVG), Photovoltaics

for Utilities (PV4U), Photovoltaics for Utility Scale Applications (PVUSA), the California Energy Commission (CEC) and the PV industry. The SMUD PV Projects have included DOE/UPVG TEAM-UP cost-share funding. Through the PV Partnership Program, SMUD works with other utilities and agencies to demonstrate and incorporate PV options; develop new market opportunities; and pursue public policies to significantly increase the energy supply share of PV technologies.

SMUD General Manager Jan Schori, in announcing SMUD's goal of 25,000 solar systems by 2010 in support of the National Million Solar Roofs Initiative, stated that the Initiative "provides the opportunity to move the nation forward towards a sustainable energy supply and in meeting environmental needs while providing profound economic development benefits", adding that SMUD is "committed to help make clean, renewable solar energy available and affordable to our customers and the nation." Ed Smeloff, Executive Director of the Pace University National Energy Policy Project and former SMUD Director has stated, "Sometime early in the 21st Century, the cost of photovoltaic energy is going to cross over with fossil fuels. I think it will be known as the Solar Century. When people look back on the 21st Century, they will say the Solar Century started in Sacramento." More importantly, Smeloff has added, "What SMUD has done to put solar technology into the hands of its customers ... could be easily replicated in community after community."

PV Pioneer Program

Since the launch of the PV Pioneer Program in 1993, SMUD has been partnering with its customers who pay an extra monthly "green fee" to host a SMUD owned PV system on top of their home. There are now over 420 residential rooftop PV systems that feed into the SMUD grid and generate about 1.6 MW of clean, renewable power for the Sacramento community as a whole. SMUD purchases, installs, owns, and operates these residential rooftop PV systems, each about 3-4 kW, adding about 100 PV Pioneer systems each year.

SMUD residential customers volunteer to share in this effort through a form of "green pricing" and by providing the roof area to place the environmentally friendly, SMUD " PV power plants". The PV Pioneer pays a $4 per month "green" premium on their utility bill to participate. In doing so, the PV Pioneers have the satisfaction of generating clean, renewable energy on their own rooftops. SMUD gains experience in the installation, operation, maintenance, pricing strategies and other aspects of residential PV systems and obtains low-cost "power plant sites." This joint effort also helps accelerate the commercialization of PV as part of a process of sustained, orderly development.

A typical 3-4 kW system uses a 400 square foot PV array. The complete PV system installation requires only half of a day. The PV system parallels on the utility side of

residential service meters and enters the utility grid through a separate utility meter mounted next to the house utility meter.

Another 30 commercial rooftop and parking lot systems, ranging from 4-130 kW, feed over 1.5 MW of solar electricity into SMUD's grid. Multiple "residential" systems are typically combined to make up a commercial building system. Several building integrated PV systems (BIPV) have been installed at SMUD and 50 new homes are planned for mid 1998 to have "energy roofs" using BIPV shingles. Two other systems have been installed as part of a DOE PVBONUS supported project with "AC PV Modules". The AC PV module incorporates a microinverter as part of the PV module. This permits the PV system to be built up from expandable, modular AC building blocks, simplifies design and installation, and eliminates the need for a central inverter.

The unused air-space above parking lots offer great potential for siting PV systems while offering the benefit of shade. Several "Solarports" have been installed by SMUD over local parking lots with more planned. These systems can also provide electric vehicle charging stations.

Since 1993, SMUD has installed six substation PV systems adding about 1 MW in distribution support generation. Two of the systems are fixed, south-facing systems with central (100 kW) inverters. Four are single-axis tracking systems, one with a

single large inverter and three with modular (16 kW) inverters and control systems. The modular design reduces engineering costs, allows each row to operate independently and provides lower maintenance costs.

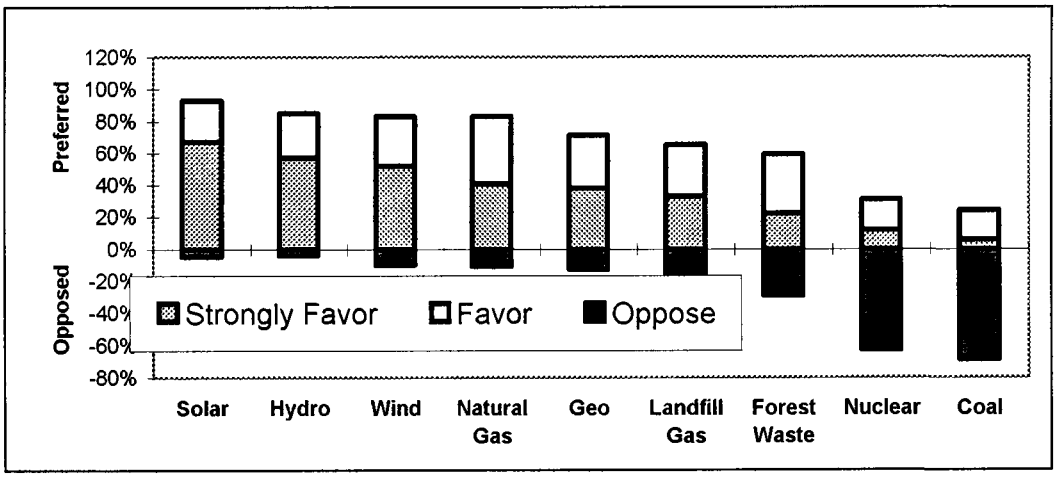
Q. What are the Customer Attitudes and Response to PV Green Pricing?

A. It is up to local communities, states, the utilities, and the public at-large to take the lead in demanding and providing the extensive use of solar energy. A 1993 market survey showed that the people of Sacramento are interested in helping to lead the way to a cleaner, sustainable future. The 1993 survey results demonstrated the willingness of SMUD customers to support "green pricing" programs for PV.

Customers willing to pay a 15% premium price for PV generated electricity from their rooftops: 26% of the general, and 57% of the "green" population .
Customers willing to pay a 15% premium with rate stabilization of the PV portion: 49% of the general, and 77% "green" population.

The customer response to the PV Pioneer Program has greatly exceeded expectations with about 500 to 1000 customers volunteering each year for the approximately 100 PV Pioneer systems available each year. Of those volunteering, about two-thirds pass a pre-qualifying screen and agree to pay the PV Green Fee premium. With the current restrictive roof requirements, qualifying rooftops have been a much greater constraint

to volunteers than the "green fee." A 1997 SMUD survey confirmed this public support with over 24% of the general public willing to pay more on their utility bill for PV, 14% willing to pay more than $10/mo and 8% more than $20/mo. As can be seen in Figure 4, the same survey showed that solar was the clear preference of customers for their energy supply and that customers expect energy providers to find ways to provide solar that is both affordable and "low-hassle".



SMUD Customer preferences for energy resources (1997).

Q. Why are Roof-top Resources important?

A. In metropolitan areas, tens of thousands of acres of residential and commercial roof area, parking lots and transmission corridors are setting unused in the sun. This unused area provides "free land" for PV power systems, does not have potential environmental impacts and is right at the load where the power produced has the highest value. In

Sacramento alone, these south-to-west oriented roofs, parking lots and transmission corridors represent the potential of over 400 megawatts for photovoltaic resource.

Power plant siting is normally a troublesome, time consuming and expensive exercise, especially in a suburban or urban area. However, over the past four years, SMUD has sited over 400 PV power plants all across Sacramento with little trouble or expense. Indeed, hundreds of customers are paying extra on their utility bill to host a SMUD PV power plant on their roof. This ease of siting combined with the environmental, modular and distributed benefits of PV add substantially to the value PV brings to the utility's energy mix.

Q. What are the cost improvements SMUD has seen due to Sustained Orderly Development?

A. The SMUD PV Program systems have shown substantial cost improvements each year. This is true both for the turn-key contract costs as well as for the costs incurred by the utility to develop, procure, administer, and perform the utility side of the systems installation and integration into the grid, as can be seen in the following table for the residential systems. The costs for the substation systems are similar. These trends are continuing as can be seen from the contracts SMUD has entered in to provide up to 10 MW of PV systems for 1998 through 2002. These contracts result in system costs

below $3/W in 2002 and positions PV to become a cost-competitive option for the retail customer.

SMUD PV PIONEER SYSTEM COSTS

YR	Turn-Key Cost	SMUD Added Cost	Total Cost	30 yr ¢/kWh*
1993	$7.70/W	$1.08/W	$8.78/W	23¢
1994	$6.23/W	$0.90/W	$7.13/W	20¢
1995	$5.98/W	$0.89/W	$6.87/W	18¢
1996	$5.36/W	$0.85/W	$6.21/W	17¢
1998	$4.25/W	$0.82/W	$5.07/W	16¢
2002	<$2.60/W	<$0.40/W	<$3.00/W	8 or 9¢

* Based on1998 real dollars, levelized over 30 years at District cost of money

SMUD'S 10 MW 1998 - 2002 SOD PV PROGRAM

The SMUD Board of Directors renewed its commitment to the commercialization of PVs through the approval of long-term contracts for a full 10 MW of PV for 1998-2002. A contract was signed with Energy Photovoltaics (EPV) for 10 MW of PV modules as well as a PV module manufacturing plant in Sacramento. Contracts were also awarded to Trace Engineering for the purchase of inverters, Utility Power Group (UPG) for balance of system (BOS) and installations, and Atlantis Energy for building-integrated PV roofing systems. These contracts further reduce the installed cost of PV systems with PV project costs of just over $5/W in 1998 to below $3/W in 2002, placing PV at a point where it can compete in the retail energy market. At this system price, the utility industry organization, UPVG - Utility PhotoVoltaic Group, expects an explosive, self-sustainable, grid-connected, domestic market.

The contracts also call for new PV module and inverter manufacturing facilities to be built in Sacramento in 1998. A Sacramento PV factory of 7 to 10 MW/year capacity will begin production in 1998 and provide 100 to 200 jobs. This multiyear, 10 MW program is being funded by SMUD with a commitment of just 0.6% of annual District revenues under the Public Goods Charge (PGC) program at SMUD. According to General Manager Schori, "This next phase of SMUD's solar program demonstrates our commitment to renewable energy sources and our role as a community leader to build environmentally friendly power plants. Expanding renewable resources is a goal that we are pursuing as we head into a competitive era."

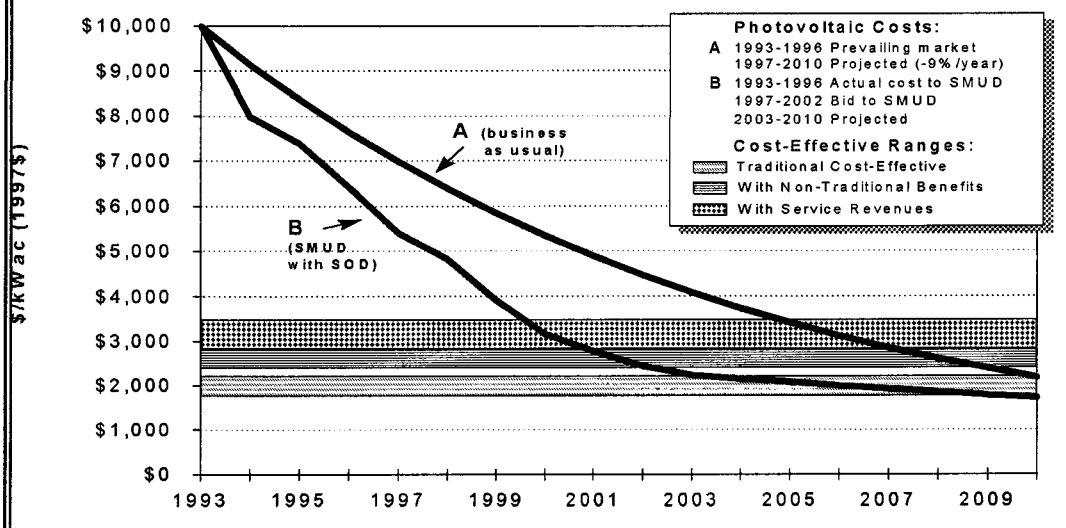
As part of SMUD's response to restructuring, the District has expanded its PV program under the AB1890 mandated PGC program. The PV Pioneer II (PVPII) program would market PV systems to customers with net metering and a cost buy-down bringing the cost to the customer down to where it can compete in the retail market. Unlike the PV Pioneer I program, PVPII customers own their system and receive the PV generated electricity on their side of the meter. By buying down the cost of the PV system to about $2.50 to $3.00/W the resulting effective cost of PV electricity would be in the competitive range in the California residential electric market. A pilot program of 50 PV Pioneer II homes in a new subdivision is underway. The PV Pioneer II Program is expected to expand in mid-1998.

SMUD is also expanding its partnerships with other municipal utilities, agencies and organizations. This will further leverage SMUD's experience and multiyear, volume purchase to expanding the impact on the commercialization of PV. The SMUD PV Partnership Program is, in part, also designed to give other California municipal utilities an effective option to allocate some of their PGCs to the commercialization of PV. SMUD can provide technical, programmatic, and procurement services under PV Partnership agreements. Through the SMUD PV Partnership Program and collaborative TEAM-UP projects, SMUD is teamed with utilities from New York to New Zealand to advance PV applications.

PV COMMERCIALIZATION COST CURVE

Photovoltaics offer many advantages as distributed generation systems, both as a supply side option and as a demand-side management option. PV's are the most modular and operationally simple of the clean, distributed power technologies. PV's non-traditional, or stacked, benefits include the value of peak period power, distribution benefits, environmental benefits, and reduced fuel price risk. PV has the important benefit of being able to compete at the retail level, not just at the more stringent, bulk power wholesale level.

From 1972 to early 1992, PV module costs had been reduced 100-fold. Already PV is a cost-effective resource for a wide variety of remote and grid-independent applications. The strategic, competitive advantages of PV continue to increase as this cost trend continues. Figure 5 shows the historic and projected costs of grid-connected, residential rooftop "PV Pioneer" like systems and the range of cost-effectiveness on the SMUD system. Curve A is the prevailing market line for business as usual purchases. Curve B is a SOD market line for large and growing, sustained orders. The 1993 to 1997 points are the actual costs of SMUD PV Pioneer systems, The 1998 to 2002 are based on SMUD contracts for the 5 year, 10 MW purchase. The cost-effective range with non-traditional benefits accounts for the full stacked benefits of a distributed PV system. The additional value from "service revenues" come from the net revenues to SMUD from sales of electricity to a 10 MW/year PV manufacturing line in the District's service area. As can be seen, despite tremendous price decreases, PV is currently about two times too costly for most grid-connected applications. However, the five year, 10 MW program closes the gap and reduces the cost of PV to where it can compete in the retail electric market.



Rooftop PV cost trajectories and cost-effectiveness ranges (constant 1997$).

Q. What are the key points for domestic PV commercialization?

A. There is a critical need to accelerate and complete commercialization of PVs in the domestic market to meet our needs for grid-connected applications beyond the year 2000. Without a sustained, collaborative effort we cannot assume that PVs will be ready to serve the utility market when we will need it. Our actions today are investments for tomorrow.

There are three central concepts necessary to achieve the production levels and cost reductions required for the accelerated commercialization of photovoltaics for utility systems:

1. Sustained Orderly Development (SOD)
2. Commercialization path life-cycle costing
3. Proactive leadership to stimulate early adoption

Sustained Orderly Development (SOD) Strategy

The solar industry needs reliable, growing and sustained domestic market volume to fully develop and to accelerate the long-term cost reductions required for full commercialization. Current "cost-effective" utility markets have not provided sufficient market volume to accelerate commercialization. Demonstration and R&D projects alone do not accelerate the commercialization of new technologies. In fact, large, one-time purchases tend to dry up supply (and thereby increase price) without stimulating the increase in production capacity necessary for manufacturing cost reductions. Manufacturers can not rely upon programs that are short-term or unreliable when making investment decisions.

SMUD embarked on a path of sustained PV procurements with the expectation that PV prices will decline as long as SMUD provided a sustained commitment to purchase PV systems in substantial quantities. Commitments for substantial, growing, and sustained capacity acquisition tied to new production capacity and aggressive price reductions are required for accelerated commercialization. This commercialization

strategy, referred to as Sustained, Orderly Development (SOD), and the economies of volume for PV systems are indeed resulting in the rapid development of a mature, cost-competitive solar industry.

Any commercialization program in PV, whether national or an individual utility, must be based on the principles of Sustained, Orderly Development if it is to maximize it effectiveness. The following principles are key to SOD:

- Reliable
- Predictable
- Substantial
- Multiyear
- Sustained

As Dr. Donald Aitken, the originator of the conceptual framework of "SOD", put it, "It is critically important to note that SMUD's rapidly reducing costs are the *result* of the utility's decision to be a substantial and consistent player in the PV market, year after year. This has been shown to be the *key* to accomplishing the economic benefits of 'sustained orderly development' of the solar electric utilities."

Commercialization Path, Life-Cycle Costing

Commercialization path, life-cycle costing, and not just "project" life-cycling costing, needs to be used. It is important to analyze total expenditures and total acquired capacity over the entire commercialization path. Higher costs for the first megawatt of a multi-megawatt, multi-year purchase can be a good investment if they contribute to accelerating the trend towards lower costs and higher performance for the following megawatts. When solar investments are selected carefully and in collaboration with other stakeholders in renewable energy development, they can be among the wisest and, ultimately, the lowest risk, long term investment that can be made, despite their higher initial capital costs.

Proactive Leadership to Stimulate Early Adoption

Accelerated commercialization will not occur just by relying on natural market forces, by demonstration projects, or by waiting and watching the cost curve. Utilities and other potential bulk purchasers must commit to early, sustained, multiyear series of substantial buys to permit the industry to invest in expanded production and automation. Programs like TEAM-UP, on a sustained basis, can help to stimulate this market pull.

Likewise, it is important to "Think Globally, Act Locally". Actions taken by individuals, by individual companies and by local communities are the actions that make the real difference. While these local actions are more effective when designed to be an effective part of a larger context, without them no global solution can exist. The SMUD Solar Program has been a clear example of the larger impacts of local action and proactive leadership.

Q. What is the Rationale for a Utility PV Business Strategy?

A. Despite the uncertainty of this time of transition as utility systems undergo restructuring and face open competition, now is the time to move forward with serious grid-connected PV commercialization and to develop and implement utility PV business strategies. There are several reasons for this including:

First, it is the popular thing to do. Most of your customers want you to provide them with access to clean, renewable power, particularly PV.

Second, it is the right thing to do. You can help to provide green and sustainable benefits. There is economic value to being "green" that can show up in improved business position.

Third, it is the smart thing to do. PVs work and are rapidly getting more affordable. Position yourself for the new business opportunities that are surely developing.

Fourth, it is low risk and low cost for a "major" effort. SMUD's PV program is based on only 0.6% of revenues. PV's modular nature makes it easy to start. Various mandated public benefits programs during this period of transition and restructuring further lower the risk; work with them.

Fifth, invest in a green future and put PV to work for you now. Position your utility business for the 21st Century.

Finally, if you don't - someone else will.

The successful, accelerated commercialization of utility PV applications needs to be a collaborative effort of many participants. Utilities, local, state and federal agencies and other stakeholders must join together. Manufacturers need to nurture the grid-connected, utility market with aggressive forward pricing. They need to invest in this market development and in new production now to create a profitable market for the future. Utilities need to implement substantial, sustained purchases. They need to aggressively account for the non-traditional benefits and future business opportunities of distributed PV generation and maximize what they can afford to invest in early

systems to accelerate the cost reduction and commercialization of grid-connected PV. Regulators need to recognize that the long term best interests of the ratepayer will be served by permitting and encouraging modest early investments in higher cost PV today when these investments will lead to earlier and greater cost reductions of PV for the future. They need to account for societal and economic development benefits and the benefit of commercializing a source of "green and inflation-proof" energy in considering utility restructuring. DOE needs to provide a reliable and predictable multi-year cost share absorbing a part of the early risk. The Federal government must show that it can be a reliable, sustained partner and not shift support up and down as the winds of the political moment shift back and forth. This process must be developed in a way that the PV industry can invest with confidence in new processes and manufacturing lines to lower costs and that utilities and their regulators can see accelerated and continuous progress to cost-effectiveness.

Efforts such as the Utility PhotoVoltaic Group's Project TEAM-UP with the USDOE , the PV4U collaborative state working groups and SMUD's PV Partnership Program offer frameworks to make the collaborative commercialization of the grid-connected, utility PV market succeed. The level of response to the PV-Compact/TEAM-UP program is indicative that the needed level of commercialization can be developed and maintained given only modest - but sustained - DOE shared-risk. These efforts, supported by all the stakeholders in the PV commercialization process, will be

necessary if PVs are to achieve the cost reductions needed to meet our needs in a reasonable time-frame and if initiatives such as the President's Million Solar Roofs Initiative are to succeed.

The use of solar energy has many benefits to utilities, our local communities, our country and the world in general. It is the most popularly supported supply of energy. Solar technology reduces the use of non-renewable resources. It is a renewable and sustainable energy source and helps improve air quality. PV power generation systems are clean, quiet and environmentally beneficial. They use no fuel and have no emissions. Each MW of PV power generated eliminates the production of more than 20,000 tons of carbon dioxide and more than 25 tons of NOx during its life as compared to the cleanest fossil fuel plants available for purchase today. Solar stimulate economic development and employment opportunities to a much greater extent than conventional sources. Solar represents a source of diversified, inflation-proof energy. By commercializing PV in the domestic market, our ability to supply and compete for the international market will be greatly enhanced. For all these reasons, PV represents an energy supply that utility customers are demanding. The question is, do we have the national will to make a modest but sustained commitment to the investment in our future that will make this a cost-effective and substantial part of our national energy mix in the timeframe that we need.

Q. Does this conclude your testimony?

A. Yes.

BEFORE THE ARIZONA CORPORATION COMMISSION

CARL J. KUNASEK
Commissioner - Chairman
JIM IRVIN
Commissioner
WILLIAM A. MUNDELL
Commissioner

IN THE MATTER OF THE GENERIC INVESTIGATION OF THE DEVELOPMENT OF A RENEWABLE PORTFOLIO STANDARD AS A POTENTIAL PART OF THE RETAIL ELECTRIC COMPETITION RULES.	DOCKET NO. E-00000A-99-0205

TESTIMONY OF J. MICHAEL DAVIS

On Behalf of

ARIZONA CLEAN ENERGY INDUSTRIES ALLIANCE ("ACEIA")

July 30, 1999

PREPARED TESTIMONY OF

MIKE DAVIS

Q. Please state your full name, title and business address.

A. My name is J. Mike Davis. I am the president and CEO of Golden Genesis. I am also the president of the Solar Energy Industries Association. My business address is 7812 E. Acoma Drive, Scottsdale, Arizona.

Q. Please describe Golden Genesis.

A. Golden Genesis is Arizona's leading PV systems supplier. It currently employs 100 people in Scottsdale. Its annual sales total $45,000,000.

Q. Who are you testifying on behalf in this proceeding?

A. I am testifying on behalf of the Arizona Clean Energy Industries Alliance ("ACEIA").

Q. What are your qualifications to testify on behalf of ACEIA?

A. I am the President of the Solar Energy Industries Association, and the President and CEO of Golden Genesis Company which is the largest solar electric systems integrator in the Americas.

From 1988 to 1993, I was the Assistant Secretary of Energy for Conservation and Renewables, now the Office of Energy Efficiency and Renewable Energy. In 1991, I received the Secretary's Award and citation entitled "Charted a new course of

industry-driven, market-oriented research and development for the Federal Government." This is the highest DOE award for management performance.

Q. Why is ACEIA and businesses involved in solar and renewable energy technologies interested in the proposed Portfolio Standard?

A. Because we want to open new markets to do business. My testimony before the Commission is intended to illustrate the significance that the solar and renewable energy industry places on the potentials of the Arizona market. We believe that the adoption of the proposed Portfolio Standard, as part of the Retail Electric Competition Rules, would mean substantial business opportunities in the state of Arizona for solar and renewable energy business. We believe this for the following reasons:

First, the size of the market that would be generated by the proposed Portfolio Standard would constitute a significant percentage of the *worldwide* market in 1998, which was 142 megawatts.

Second, the approach under consideration in the Portfolio Standard is market-based instead of project-oriented with a central collection and distribution entity.

Third, Arizona's abundant solar resource makes it the natural place in the United States to be the leader in the development of solar energy markets.

Fourth, the size of the *domestic* market that would be generated by the Portfolio Standard would give the industry a focal point to fully develop its capabilities and infrastructure that will enable it to serve larger and larger markets in the U.S.

Fifth, incentives in the Standard that favor Arizona-produced products would ensure that Arizona would become a national center for the industry.

Finally, the production and installation of solar technologies is good business for Arizona because is would lead to the creation of high-quality jobs, an increased technology industry base, an infusion of investment capital into the state, a cleaner environment, and an enhanced tax base.

Q. What is the profile of the solar energy market and how would the passage of the proposed Portfolio Standard enhance it?

A. In 1998, the worldwide market for photovoltaics was 142 MW. Of that market, U.S. industry captured about 40%. Importantly, about 70% of U.S. production was exported. The message in this breakdown is that there is considerable room for the U.S. domestic market to grow. We believe that significant growth in the domestic market is necessary to allow the U.S. industry to maintain its lead in worldwide market while offering the industry the opportunity to enhance its distribution and installation infrastructure to ensure that solar becomes a substantial part of Arizona's energy mix.

We also believe that because the PV industry specifically is in a stage of early commercial growth, should Arizona take this leadership role in domestic market development, it would position the state very well to become the "Silicon Valley" of the renewable energy industry. The standard before the Commission has the potential to offer this level of domestic market growth.

While there are a number of ways to project the market impact of the environmental standard, our analysis shows that 100 MW of PV would be purchased over the next five years to meet the guidelines of the Standard. This is clearly a significant market and would amount to fully 70% of the 1998 worldwide market. This size market would draw considerable attention from the industry and the financial/investment community and place Arizona squarely in the leadership role of preparing this country to meet its future energy requirements in an environmentally sustainable manner.

Q. Would the proposed Portfolio Standard lead to the formation or relocation of new solar energy businesses in Arizona?

A. Almost certainly. The manufacture and deployment of solar technologies can be broadly broken down into three major categories – 1) the manufacture of the panels (either PV or SHW), 2) the connection of those panels with either electrical power conditioning or plumbing components, and 3) the installation of those systems at the site of deployment. We believe that, as the proposed Portfolio Standard is structured, Arizona would see business growth in all three of these industry sectors for both PV

and SHW, particularly if tradable energy production credits are included in the standard for equipment produced in Arizona.

From the business strategy perspective, a local presence for installation businesses would be the most efficient manner to serve a market of this size, so it is believed that business formation, relocation, and growth would occur in this sector regardless of the disposition of tradable credits. However, the manufacturing sector of the industry would be strongly encouraged to have a local presence to seek a competitive advantage by allowing their customers to take full advantage of the "locally-produced" credits. It is the manufacturing and assembly sectors that will provide high-quality technology manufacturing positions to the citizens of Arizona, while drawing in the most substantial amounts of investment into the Arizona economy.

Q. Please describe the type of manufacturing business that would likely locate in Arizona as a result of the proposed Portfolio Standard?

A. The most likely type of manufacturing business that would locate in Arizona in the short term would be a PV module manufacturing and systems assembly business. A profile of this type of business would be as follows:

1. Module production capacity of between three and five megawatts per year;
2. Modules produced would be integrated into systems for a large variety of applications including remote off-grid systems as well as larger grid-tied systems;

3. Investment capital into Arizona of approximately $3 million;

4. Employment of up to 65 people;

5. Payroll of $8.5 million over first five years; and

6. Annual revenues of up to $40 million.

The potential market in Arizona could support a number of these types of facilities. As the market becomes more established and as prices fell, it is plausible that larger facilities would be established including silicon growing, silicon wafer production, and solar cell fabrication businesses.

Q. How would the proposed Portfolio Standard effect an existing business in Arizona?

As the President and CEO of Golden Genesis, I will use this company as an example of how the proposed Portfolio Standard would effect an existing business in Arizona. In 1998, Golden Genesis, whose primary operations are in Scottsdale, Arizona, had revenues of $48 million on sales of 4.5 megawatts of PV systems. Assuming the standard generated a market over the first five year of 100 MW, Golden Genesis could reasonably expect to capture 20% of that market leading to an additional 20MW sold over the five year period. If this were the case, our annual revenues would roughly double. Under this scenario, the number of Golden Genesis employees would increase from its current 100 to 150. Additionally, this local market would afford Golden

Genesis the opportunity to build the local installation and maintenance infrastructure necessary for PV to become a mainstream energy source for Arizona.

Q. Would the proposed Portfolio Standard lead to prices for consumers that would be more competitive with conventional energy production costs?

A. Yes. The market size and associated manufacturing scale-up, coupled with the structure of the tradable credits will combine to reduce the retail costs of solar energy for Arizona consumers.

Historical trends in the industry have followed fairly standard technology manufacturing-capacity-versus-cost curves. In 1980, when the worldwide market for PV was about four megawatts, the price of electricity produced by a PV system was about $50 per kilowatt-hour. Recent data show that the current cost of PV generated electricity is in the range of $0.15 to $0.30 per kilowatt-hour, depending on the type of system. While these numbers are still not competitive with the costs of producing base-load power, that are getting into the range of competing with the retail costs of electricity. And clearly, tremendous progress has been made by the industry in reducing costs and increasing reliability. This trend will continue and even accelerate under the environmental portfolio standard.

In addition to benefits realized from increased production capacity, tradable credits will also play a significant role in reducing the retail costs of solar energy to Arizona

consumers. The table below illustrates the impact of tradable credits on the effective price of electricity produced from a one kilowatt PV system – the type of system that could be easily mounted on a residential rooftop in Arizona.

	With 2 Tradable Energy Production Credits	Without Energy Production Credits
System Size	1 kilowatt	1 kilowatt
Sample System Retail Cost	$10,000*	$10,000
Location	Phoenix	Phoenix
Annual Average Production	2,200 kilowatt hours	2,200 kilowatt hours
Levelized Energy Costs over 30 Years	$0.15 per kilowatt hour	$0.15 per kilowatt hour
Credit Amounts	4,400 kilowatt hours	0 kilowatt hours
Annual Credit Value at $.045 per kWh Credit	$198	$0
Credit Value Over 30 Years	$5,940	$0
Effective Levelized Energy Costs Including Credits	$0.06 per kilowatt hour	$0.15 per kilowatt hour

*All dollars expressed in 1999 values

As can be seen, if a consumer purchases a system in a manner that makes that system eligible for two full tradable energy production credits, the effective cost of energy produced by that system is competitive with retail electricity rates in many parts of Arizona. This example assumes 0.5 credits for distributed generation; 0.5 credits for generating energy in-state; 0.5 credits for deploying a system within the first year of the environmental standard; and 0.5 credits for purchasing locally manufactured hardware. These types of systems are already being deployed on the Navajo Reservation as a result of a business arrangement between Golden Genesis and the Navajo Tribal Utility Authority. If tradable credits are included as part of the portfolio standard, solar energy will be made more affordable for a large cross section of Arizona's population. This will grow the market, increase demand, and further drive down solar energy retail prices. To meet this demand, companies like Golden Genesis will hire more workers, which will benefit Arizona's economy and improve Arizona's economic and environmental standard of living.

Q. What impact would the solar industry's growth associated with the proposed Portfolio Standard have on Arizona's economy?

A. The implementation of the proposed Portfolio Standard and the associated solar energy industry growth would have a demonstrable, positive effect on Arizona's economy. To specifically assess the impacts of the standard on Arizona's economy, the assumption of 100 MW of new PV generating capacity over five years will be

used. Assuming an average selling price of $8,500 per kilowatt, this level of market has the potential to impact the Arizona economy in the following ways:

1. Approximately 750 jobs will be supported by the new production in the fifth year;
2. $850 million in economic activity will be infused into the Arizona economy over the five-year period;
3. $74 million of additional payroll into the economy over the five year period, resulting in $3.7 million of personal income tax revenue for Arizona; and
4. $41,650,000 in sales-tax revenue for Arizona.

Additionally, local governments will realize the benefits of an enhanced tax base through local sales taxes.

Less easily quantified, but real nonetheless, are economic multipliers associated with local production of solar technologies. To the extent the environmental portfolio standard encourages local production, the citizens of Arizona spend their energy dollars for energy technologies produced in Arizona by their neighbors, keeping those dollars in Arizona, instead of exporting those dollars to other states or countries for the purchase of coal and oil.

Q. What is your conclusion regarding the proposed Portfolio Standard?

A. The market-based Portfolio Standard under consideration by the Corporation Commission would have a material, positive impact on the growth of the solar energy industry, both on the state and national levels. Adoption of the standard by the Commission would place Arizona squarely in its rightful place as the national leader in solar energy market development. The standard would help to meet Arizona's power requirements in an environmentally benign manner while creating hundreds of millions of dollars in economic activity, generating millions of dollars for a diversified tax base, and creating hundreds of new high-quality, high-tech jobs. This action would also clearly begin to address a strong public desire for renewable energy generation. According, we strongly urge adoption of the Portfolio Standard to grow this important industry, and to build a better economic and environmental quality of life for the citizens of Arizona.

Q. Does this conclude your testimony?

A. Yes.

BEFORE THE ARIZONA CORPORATION COMMISSION

CARL J. KUNASEK
Commissioner - Chairman
JIM IRVIN
Commissioner
WILLIAM A. MUNDELL
Commissioner

IN THE MATTER OF THE GENERIC INVESTIGATION OF THE DEVELOPMENT OF A RENEWABLE PORTFOLIO STANDARD AS A POTENTIAL PART OF THE RETAIL ELECTRIC COMPETITION RULES.	DOCKET NO. E-00000A-99-0205

TESTIMONY OF WILLIAM GOULD

On Behalf of

ARIZONA CLEAN ENERGY INDUSTRIES ALLIANCE ("ACEIA")

July 30, 1999

PREPARED TESTIMONY OF

WILLIAM GOULD

Q. Please state your name, title and business address.

A. My name is William Gould. I am a Project Manager at Bechtel. My business address is 50 Beale Street, San Francisco California, 94510.

Q. Please describe Bechtel?

A. San Francisco-based Bechtel is one of the most prominent engineering and construction firms in the world. Bechtel is engaged in a wide variety of projects in transportation, energy , power water and environmental services. Both the Washington, D.C. metro and the San Francisco Bay Rapid Transit ("BART") systems were designed and built by Bechtel. Recent projects include Attiko Metro, a subway system for Athens, Greece; program management for Hong Kong's Chek Lap Kok airport and associated infrastructure; and a 695-megawatt power plant in Dabhol, India.

Q. Who are you testifying on behalf in this proceeding?

A. I am testifying on behalf of the Arizona Clean Energy Industries Alliance ("ACEIA").

Q. What is the purpose of your testimony?

A. To present the status of solar trough electric power technologies and to support the implementation of the proposed Portfolio Standard.

Q. Has solar trough electric power technology been deployed commercially?

A. Yes. For example, nine Solar Electric Generating Station power plants, with a combined output of 354 MWe, are currently in operation in the Southern California desert. Each of the hybrid solar-fossil plants use parabolic trough collectors to capture solar thermal energy, and a steam turbine for converting thermal energy to electric energy. Each of the nine plants continues to operate reliably, and with predictable annual solar-to-electric performance. In addition, continuing improvements in plant efficiencies, and reductions in operation and maintenance costs, have allowed the plants to remain profitable well beyond the expiration date of the original Standard Offer power purchase contracts.

The plants have also demonstrated the excellent match of trough technology to southwestern utility peak power loads. For example, each of the five plants located at the Kramer Junction location has generated in excess of their design rated capacity during the SCE summer on-peak period during each summer month of each of the last 10 years.

A new application of solar trough power has been under evaluation and development over the past several years that significantly improves the cost and performance of the technology compared with the California experience. The application, which is ready for immediate commercial deployment in Arizona, is to integrate a field of solar trough collectors with state-of-the-art, high efficiency combined-cycle power plants.

Q. Please provide a technical description of commercial solar trough electric power technology?

A. A conventional combined-cycle plant consists of a gas turbine-generator, a heat recovery steam generator, and a steam turbine-generator. The gas turbine-generator consists of a compressor, a combustor, and a turbine. Air is compressed in the compressor, and then directed to the combustor. Natural gas is added to the compressed air, and the mixture is then burned to produce combustion gases at a temperature of about 2,500°F. The gases are expanded through the turbine, producing electric power. The turbine exhaust, at a temperature of about 1,100°F, flows to the heat recovery steam generator. Here, the gases are cooled in a series of heat exchangers, producing steam at temperatures up to 1,050°F. The steam is directed to the steam turbine to produce additional electric power. The latest generation of combined cycle plants operate with fuel conversion efficiencies up to 60 percent; in contrast, pulverized coal plants have efficiencies in the range of 35 to 38 percent.

Solar Trough collector fields capture solar heat and convert it to steam at temperatures up to 710°F. In this form, the solar steam can be used in a variety of thermodynamically optimal ways within the combined cycle power system.

Saturated high pressure steam. The solar steam is combined with the saturated steam flow from the high pressure evaporator, and the combined flow is superheated in the heat recovery steam generator for use in the high pressure turbine.

Superheated cold reheat steam. The solar steam is combined with the cold reheat steam at the exit from the high pressure turbine, and the combined flow is superheated in the heat recovery steam generator for use in the intermediate pressure turbine.

Superheated steam for gas turbine power augmentation - The solar steam is mixed with the gases in the combustor and heated to the normal turbine inlet temperature of 2,500°F; the added steam flow increases the power output of the plant by increasing the mass flow rates through both the gas turbine expander and the heat recovery steam generator.

Q. Are there advantages and costs savings with an integrated plant utilizing solar trough electric power technology.

A. Yes. The advantages and costs savings are as follows:

First, the concept can be applied to both industrial and aeroderivative gas turbine-generators, and with plant sizes ranging from 50 to 750 MWe.

Second, combined cycle plants are, in many instances, the design of choice for independent power producers. The plants offer high fossil-to-electric conversion efficiencies, moderate capital costs, short construction schedules, and low emissions.

Third, the collector and steam generator designs are essentially identical to those used in the existing Solar Trough power plants in California; thus, the technical and financial risks are both well understood and manageable.

Fourth, by taking advantage of and using the high efficiency power system in the combined cycle, the overall costs of the "incremental" solar plant decreases dramatically. New solar trough plants using the conventional approach of a dedicated steam turbine for power production would cost in the range of $2500/kW to $3500/kW. Using solar trough power optimally integrated with a new, state-of-the-art gas power combined cycle, the incremental solar plant costs will range from $1200/kW to $1900/kW.

The conversion efficiency of solar energy to electric energy increases from 38 percent in a Solar Electric Generating Station to as high as 45 percent in an integrated plant. The increase is due, in part, to the more efficient use of thermal energy in the exhaust from the gas turbine.

The daily startup losses for the solar facility are minimal because the heat recovery steam generator and the steam turbine-generator operate on a continuous basis. Thus, the annual conversion efficiency of solar thermal energy to electric energy is improved.

Q. Does Bechtel Corporation believe that Arizona is a good location for deployment of its commercial solar trough electric power applications?

A. Yes. Numerous desert sites in Arizona should provide ideal locations for the integrated plants. The combination of high annual direct normal solar radiation (at least 2,700 kWh/m^2) and favorable latitudes (below 35°) will produce high annual thermal outputs from the collector field. The high outputs, in turn, will help to minimize the cost of solar electric energy from the project.

As electric markets undergo restructuring in Arizona, several new high efficiency combined cycles are being developed throughout the State. The aggressive Renewable Portfolio Standard that has been proposed, if fully implemented in the near future, would allow for the confluence of a new gas combined cycle with new solar trough power systems to be pursued and implemented in a highly economic and timely manner.

This new Integrated Solar/Combined Cycle System approach is now viewed world wide to be the best near-term application of bulk solar power. Many countries throughout the world's sunbelt have been evaluating such plants, and projects are in various stages of development. Mexico, Egypt, India, Morocco, Jordan, Spain, Greece, Morocco, and South Africa are among countries that have taken an active interest in solar trough power projects outside of the US. After a long evaluation, the World Bank has identified integrated solar trough combined cycle power as the preferred bulk solar power option, and is working closely with many of the countries

identified above to develop such projects.

Q. Please summarize your support for the Portfolio Standard.

A. Early development of a solar trough combined cycle plant under the RPS in Arizona would help accelerate development of similar projects abroad, and Arizona would become a global focal point for the technology and know-how. The in-state plant will generate hundreds of engineering and construction jobs in the local economy during the construction period. Much of the bulk plant materials will be sourced from Arizona companies. After commissioning, several dozen permanent operation and maintenance jobs will be created in the local community. Overall, a good economic basis will be created in Arizona for this technology from which to serve a growing global demand for new solar trough power.

A new solar trough combined cycle plant in Arizona would generate solar electricity in a cost range of 12 cents/kWh to 18 cents/kWh. A robust solar portfolio in Arizona that would result in the deployment of bulk solar trough power along with distributed PV and dish Stirling power as well as Domestic Hot Water would provide a solid range of solar energy options for the state to build on. A mix of high value distributed options with lower cost bulk power and hot water option will result in an overall solar portfolio that will be modest in cost for Arizona energy consumers.

In order for a large (25 MW to 30 MW) solar trough power system to proceed within the RPS it is crucial that the proposed standard ultimately applies to all Arizona

electricity consumers, the roll out of the standard remains as proposed, and the applicable percentages remain as proposed. It is also crucial that the Commission institute the RPS in a manner that creates a high degree of market certainty for participants. In particular, it important that the RPS statutes encourage Electric Service Providers and Utility Distribution Companies to enter into at least 10 year power purchase contracts with solar energy producers.

Q. Does this conclude your testimony?

A. Yes.